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US AMLR Vessel Survey (*R/V Yuzhmorgeologiya*)
South Shetlands, Antarctica

Oceanography

The crew experienced gray skies, rain, snow and rough seas for most of the Elephant Island Area, with the worst storm occurring on the 22nd and 23rd of January. A series of small low-pressure systems crossed the area and produced a confused sea state for most of the sampling dates. Although the barometric pressure dropped only 42 millibars during the strongest storm, winds were strong and peaked at more than 50 knots over a 6-hour period. The confused sea state prior to the storm contributed to intermediate seas of up to 6 meters.

Despite challenging conditions, the oceanographic crew successfully completed 47 CTD stations across the Elephant Island Area. Where CTD casts were not possible, XBTs were launched to collect environmental data.

A series of minor electrical gremlins caused a data-logging computer to crash, resulting in the partial loss of some data. No other problems were encountered, besides the normal underwater connector maintenance. Work resumed once the CTD/SCS computer was replaced, approximately 2.5 hours later.

Phytoplankton distribution in the West Area and in the western portion of the Elephant Island Area

Chlorophyll-a (Chl-a) concentration values were monitored at each station to estimate phytoplankton biomass. In the West Area, Chl-a averaged 0.58 ± 0.59 mg m-3 at 5 m depth in the West Area. Elephant Island Area values averaged 0.70 ± 0.57 mg m-3 over 25 stations at 5 m depth.

In both Areas, there is a significant difference in the distribution and biomass of phytoplankton in pelagic waters (depth > 1000 m) as compared to coastal waters:

- In the West Area, Chl-a concentration values were 0.37 ±0.48 mg m-3 in pelagic waters and 1.04 ± 0.60 mg m-3 in coastal waters.

- In the Elephant Island Area, Chl-a concentration values were 0.48 ± 0.57 in pelagic waters and 1.02 ± 0.41 in coastal waters.

These values are comparable to the 18-year mean values at 5 m depth recorded during Leg 1 between 1990 and 2007:

- 0.52 ± 0.83 mg m-3 in pelagic waters and 1.14 ± 0.98 mg m-3 in coastal waters for the West Area.

- 0.39 ± 0.56 in pelagic waters and 1.3 ± 1.3 in coastal waters for the Elephant Island Area.

The data were monitored for the presence of a Deep Chlorophyll Maximum (DCM), which is indicative of iron limitation of phytoplankton biomass in the upper mixed layer. Data from *in-situ* Chl-a fluorometer and extracted Chl-a concentration values from depths of 5, 30, 50, 75, and 100 m at every station showed a DCM between 60 m and 90 m at nearly all the stations located in pelagic waters. No DCM was evident at any of the coastal stations. Iron limitation primarily occurs in the upper mixed layer of the Antarctic Circumpolar Current (ACC) waters and is a clear indication of the patterns of mixing occurring between various sources of coastal waters in the AMLR Survey Areas.

Acoustic estimate of krill biomass

Stormy weather affected the sampling of the Elephant Island Area, complicating the estimation of acoustically determined krill biomass. However, with additional filtering of the acoustic data, we were able to estimate that krill biomass (g/m2) along individual transects was very low, at less than 0.25g/m2. This data concurs with the data collected in the West Area last week, which also produced low biomass estimates along individual transects.

Total krill biomass, estimated using the three-frequency krill algorithm, as well as the SDWBA technique, showed that biomass was less than 10,000 tons! This is an extremely low value for this Area, and is much lower than historical estimates. In fact, krill biomass is usually higher in the Elephant Island Area than the other Areas sampled during the AMLR cruises.

Similar to what was observed in the West Area, a large signal from other scatterers was present in the Area. Final analysis of the data has not been conducted, and definitive estimates of occurrence and distribution await the completion of the survey.

Estimate of krill and zooplankton abundance and distribution

Krill and zooplankton were collected at 47 stations in the Elephant Island Area using the standard IKMT net and protocol. Postlarval krill were represented in 43 of the 47 samples from the Elephant Island Area with a mean concentration of 23 (+/- 74) per 1000 m3, four times that in the West Area. The two largest catches were made northeast of Elephant Island and contained 1530 and 2340 individuals (264 and 452 per 1000 m3). The overall abundance statistics were quite similar to those monitored in this area during January 2002 and represent below average values within the long-term data set. The interpretation of the abundance of krill is similar to that determined using the acoustic data.

Lengths ranged from 16 to 58 mm but demonstrated a clear bimodal distribution around 44 and 48 mm representing two- and three-year-old krill from the 2006 and 2007 year classes. Males outnumbered females by ca. 2:1 and 95% of all individuals were sexually mature. Interestingly, the two length modes were largely due to contributions by two-year-old females and three-year-old males. Three-year-old males also dominated the West Area catch.

Nearly 90% of the mature females were in advanced stages (with ovarian development, gravid and spent) indicating that krill were actively mating and spawning during the survey period. The increased frequency (ca. 50% of samples) and abundance of early calyptopis stage larvae here compared to the West Area suggests that the major seasonal spawning effort was initiated two to three weeks ago (late December-early January).

The aggregate form of the *Salpa thompsoni* numerically dominated zooplankton catches for the first time since 2005. The mean abundance estimate, 1334+/-2900 per 1000 m3, is the largest encountered in the Elephant Island Area during January, while the median catch (454 per1000 m3) was similar to values recorded in 1993, 1994, 1998 and 2005. This year small aggregate salps are predominant in the catches, while in previous years large aggregates (>35 mm) were common. The presence of smaller aggregates suggests a delayed chain production period, probably starting around early to mid-November.

With mean and median concentrations of 786 ± 1000 per 1000 m3 and 346 per 1000 m3, copepods are similar to *S. thompsoni* in abundance. These abundance values are similar to those encountered over the last two January surveys. The copepod assemblage differs however, in the paucity of the coastal species *Metridia gerlachei* and dominance by small, unidentified species. In terms of mean abundance, larval and postlarval *Thysanoessa macrura*, chaetognaths and *Limacina helicina* were relatively important components of the zooplankton assemblage.

Seabird and mammal observations

Data on the distribution, abundance and behavior of seabirds and mammals were collected during underway ship operations in the Elephant Island Area. Forty transects were collected totaling approximately 690 nautical miles of survey effort. The seabird community consisted primarily of (percentage-wise): cape petrel, chinstrap penguin, prion, blue petrel, southern fulmar, white-chinned petrel, black-browed albatross, gentoo penguin, Wilson's storm petrel, black-bellied storm petrel, gray-headed albatross, southern giant petrel, light-mantled albatross, and wandering albatross. Blue petrels, prions, and white-chinned petrels were highly conspicuous in offshore waters, especially near the Shackleton Fracture Zone. A strikingly similar pattern was observed in 2005, when oceanographic conditions were similar to this year, which may suggest a link between seabird community composition and changes in oceanographic conditions.

Seabird feeding aggregations (composed of cape petrels, black-browed albatrosses, gray-headed albatross, white-chinned petrel, and prions) displayed a high degree of patchiness and were distributed in a few locations situated along the shelf-break to the west of Elephant Island, north of Clarence Island, and offshore in the northeast corner of the Elephant Island grid. We found a similar spatial arrangement of seabird aggregations during 2006, when krill biomass was exceptionally low.

On 19 January we encountered a pod of 5 killer whales (60.34 S, -57 W) that just made a kill. We were unable to determine what they were eating, but some video footage was captured. Thousands of birds, mostly cape petrels, albatrosses, storm petrels, white-chinned petrels, and prions congregated around the feeding frenzy.

A total of 225 fin whales (114 sightings) were observed. This is the highest number of sightings ever recorded during a January AMLR survey. Based on past AMLR surveys (6 years), we have found that fin whales tend to concentrate in offshore waters of the Elephant Island Area, especially in the northeast corner. However, this year fin whales were more broadly distributed throughout pelagic waters, the shelf-break region, and in waters farther south of Elephant Island. In addition, an all-time low number of humpback whales were recorded (3 sighting, 6 animals). Two sightings of southern bottlenose whales were made near the Shackleton Fracture Zone.

Report submitted from a foggy southern ocean by AMLR researchers aboard the *R/V Yuzhmorgeologiya*, conducting surveys of the pelagic ecosystem in the peninsula region of the Antarctic under the watchful eye of Chief Scientist Christian Reiss. These reports are posted at http://swfsc.noaa.gov/aerd-field.aspx ; blogs from the field are also posted at the same website. Photos by M. Goebel (NMFS/AERD).